

GEO-flow®

Pipe Leaching System

Design, Installation and Operating Manual

Massachusetts

July 2008

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I. INTRODUCTION

The purpose of this manual is to provide the minimum design and installation information for the use of the ADS **GEO-flow® Pipe Leaching System** in the State of Massachusetts. Any exceptions or changes to the design or procedures must be confirmed by ADS., Inc. Any revised version of this manual supersedes all previous versions.

Pursuant to Title 5 of the State Environmental Code 310 CMR 15.000, the ADS GEO-flow® Pipe Leaching System is approved for general and remedial use in Massachusetts by the Department of Environmental Protection.

This manual provides a brief description of the GEO-flow Pipe Leaching System and its applications in Massachusetts. For more information, or for answers to questions or concerns, please call ADS at our Northeast Zone office at the number listed below, or contact your local ADS representative.

The GEO-flow Pipe system is an advanced alternative to the stone and pipe components of a conventional effluent disposal system. The GEO-flow Pipe product is fabricated at our plants using ADS manufactured corrugated polyethylene pipe. This large-diameter pipe is encased in a symmetrical polypropylene grid, which is then wrapped in a specifically designed geotextile. This patented design, when installed in 6 inches of specified "system sand", creates a system that is significantly more efficient than conventional pipe and stone.

GEO-flow Pipe is lightweight, and does not require the use of stone. Therefore, it may be delivered to and constructed in areas where conventional pipe and stone systems would be difficult to install.

GEO-flow Pipe has been used successfully for more than 15 years for both residential and commercial installations throughout Maine and New Hampshire. System designers can specify GEO-flow Pipe with confidence in the knowledge that the GEO-flow Pipe product they install in each and every system will be fully backed by ADS.

II. THE GEO-flow PIPE SYSTEM

Each GEO-flow Pipe Leaching System is comprised of the following components:

- complete 10' GEO-flow pipe sections
- couplers
- end caps
- offset adapters
- system sand

1. GEO-flow Pipe Sections

GEO-flow Pipe sections come in 10-foot lengths. Each section is comprised of the following:

- ADS manufactured corrugated high-density polyethylene pipe. This pipe is perforated to allow for effluent to pass through its sidewalls easily and at varying heights. This pipe is encased in a:
- symmetrical polypropylene grid, which is wrapped in a:
- specially designed, non-woven plastic geotextile fabric.

II. THE GEO-flow PIPE LEACHING SYSTEM (continued)

The GEO-flow Pipe sections function in a number of ways. The geotextile fabric establishes a distinct surface at which bacterial growth and activity will take place. This material will restrict the flow of effluent leaving the corrugated pipe, and biomat will naturally occur on its surface as a result. In addition, the large-diameter corrugated pipe creates a dispersal medium where effluent introduced into the system is constantly changing elevations. This changing of elevations encourages and enhances the bacterial activity within the biomat, thereby maximizing its function. The large diameter pipe also serves as a repository for suspended solids that may inadvertently exit the septic tank. Finally, the polypropylene grid between the pipe and the fabric creates a substrate for bacterial communities while aiding in the distribution of effluent around the entire circumference of the pipe.

2. Offset Adapters

Offset adapters are end caps fitted with a 4-inch offset hole at the 12 o'clock position.

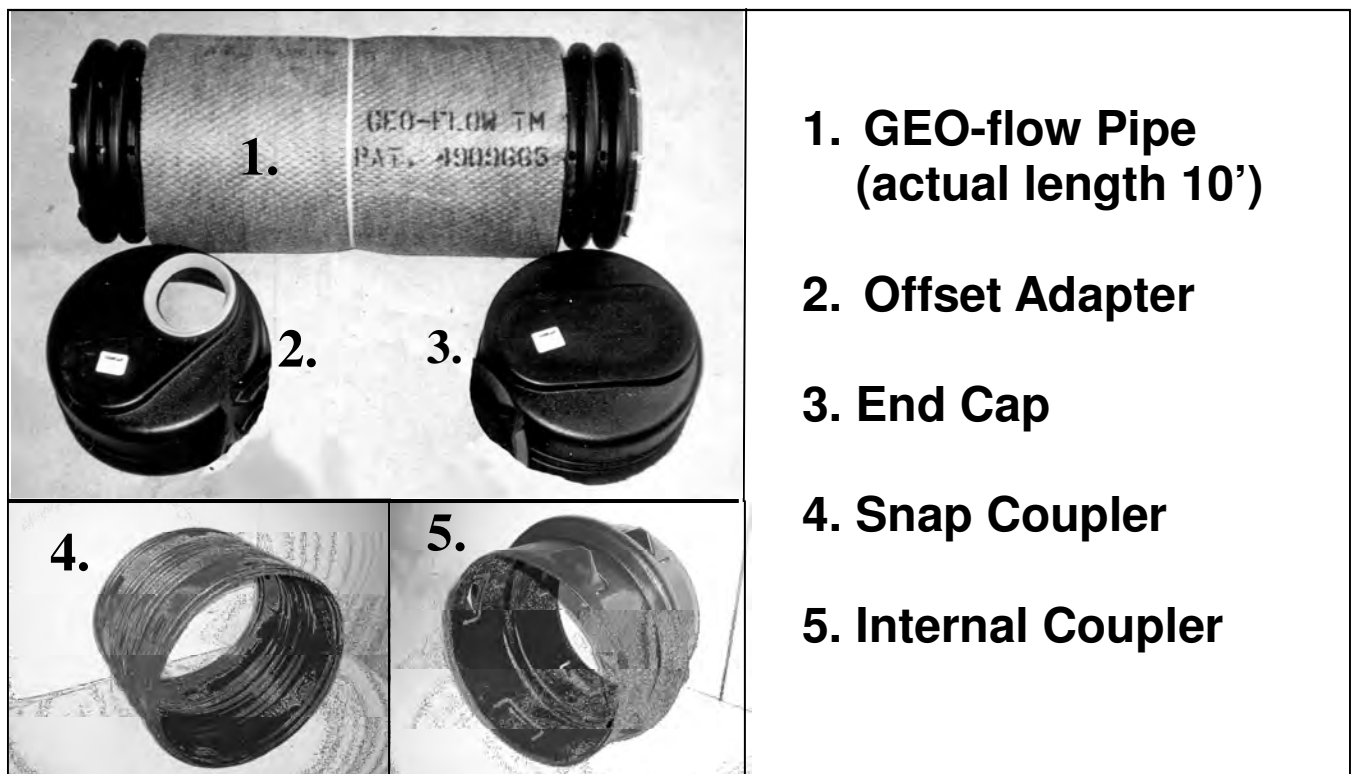
3. End caps

End caps are molded to fit snugly on the end of any GEO-flow Pipe section to close the line.

4. & 5. Couplers

Couplers are ADS manufactured fittings that join two sections of GEO-flow Pipe. They are offered in two styles:

- *snap couplers* are laid around the ends and easily snap together to engage one GEO-flow Pipe section to another.
- *internal couplers* fit within the ends of two GEO-flow Pipe sections to create a GEO-flow pipeline.



II. THE GEO-flow PIPE LEACHING SYSTEM (continued)

6. System Sand

All GEO-flow Pipe Leaching Systems installed in Massachusetts require a minimum of six inches (6") of "system sand" surrounding the entire circumference of the pipe.

"System Sand": "System sand" shall meet ASTM C-33 (concrete sand) requirements.

Surrounding Backfill Material: Material around the remainder of the system may be either additional system sand or material that meets the requirements of 310 CMR 15.255(3).

Bed Material: Beds which slope 10% or less require the system sand area to extend a minimum of one foot (1') around the perimeter of the GEO-flow pipe bed. Beds which slope more than 10% require the system sand area to extend a minimum of one foot (1') around the GEO-flow pipe, and an additional six inches (6") of system sand, measured from the bottom of the GEO-flow pipe, must extend 3' on the downward side.

Fill Extensions: Raised systems that include a slope of 10% or less require three-foot (3') extensions on each side (including system sand, surrounding sand, and topsoil) before tapering. Raised systems that include a slope of greater than 10% require three-foot (3') extensions on three (3) sides and a five-foot (5') extension on the down slope side before tapering. Tapering shall be 3:1 or less.

All mounded systems shall be designed and installed in accordance with 310 CMR 15.255.

Sand Specifications:

The approved "system sand" shall meet ASTM Standard C-33 (concrete sand), or the following specification:

Percentage Restrictions

35% or less of the total sand may be gravel.

40%-90% of the total sand is to be coarse and very coarse sand.

Gravel Quality Restrictions

No gravel is to exceed $\frac{3}{4}$ " in diameter.

No gravel is smaller than 2mm/.0787" in diameter. (It must not pass through a #10 sieve.)

Coarse Sand Quality Restrictions

No coarse sand is smaller than 0.5mm/.0196" in diameter. (It must not pass through a #35 sieve.)

Fines Quality Restrictions

No more than 2% of the total sand may pass through a #200 sieve.

III. ADS GEO-FLOW PIPE LEACHING SYSTEM SPECIFICATIONS

Scope:

This specification describes ADS GEO-flow available in 10-inch (250 mm) diameter pipe for use in on-site waste disposal applications in Massachusetts.

Pipe Requirements:

ADS GEO-flow pipe shall meet the requirements of ASTM F667. It shall have a corrugated interior and exterior. There shall be eight 7/16 inch (9.5 mm) holes evenly spaced 45 degrees apart per corrugation continuing the full length of the pipe. The pipe shall be shipped with a pre-installed reinforcing geo-grid fabric and 4 ounce geotextile fabric.

Joint Performance:

Pipe shall be joined with internal or external couplers covering at least two full corrugations on each end of the pipe.

Material Properties:

Pipe material shall be high density polyethylene conforming to the minimum requirements of cell classification 424410C as defined and described in ASTM D3350.

Geo-Grid Fabric:

Min. Tensile Strength: ASTM D4595; 400 lb/ft.

Min. Transmissivity: ASTM D4716; 1×10^{-3} m²/sec @ 1 and vertical load: 10,000 psf

Min. Density: ASTM D1505; 0.940 g/cm³

Typical Melt Flow Index: ASTM D1238; 1.0 g/10 min.

Min. Carbon Black Content: ASTM D4218; 2 %

Min. Thickness: ASTM D5199; 5.0 (200) mm/(mil)

Min. Unit Weight: ASTM D3776; 20 oz/sy

4 oz. Geotextile Property Specification:

Fiber: Polyester

Substrate: None

Weight: 4.0 oz/yd² +/- 0.04 oz/yd²; FTM NW503

Thickness: 0.065 inch +/- 0.010 inch; FTM NW504

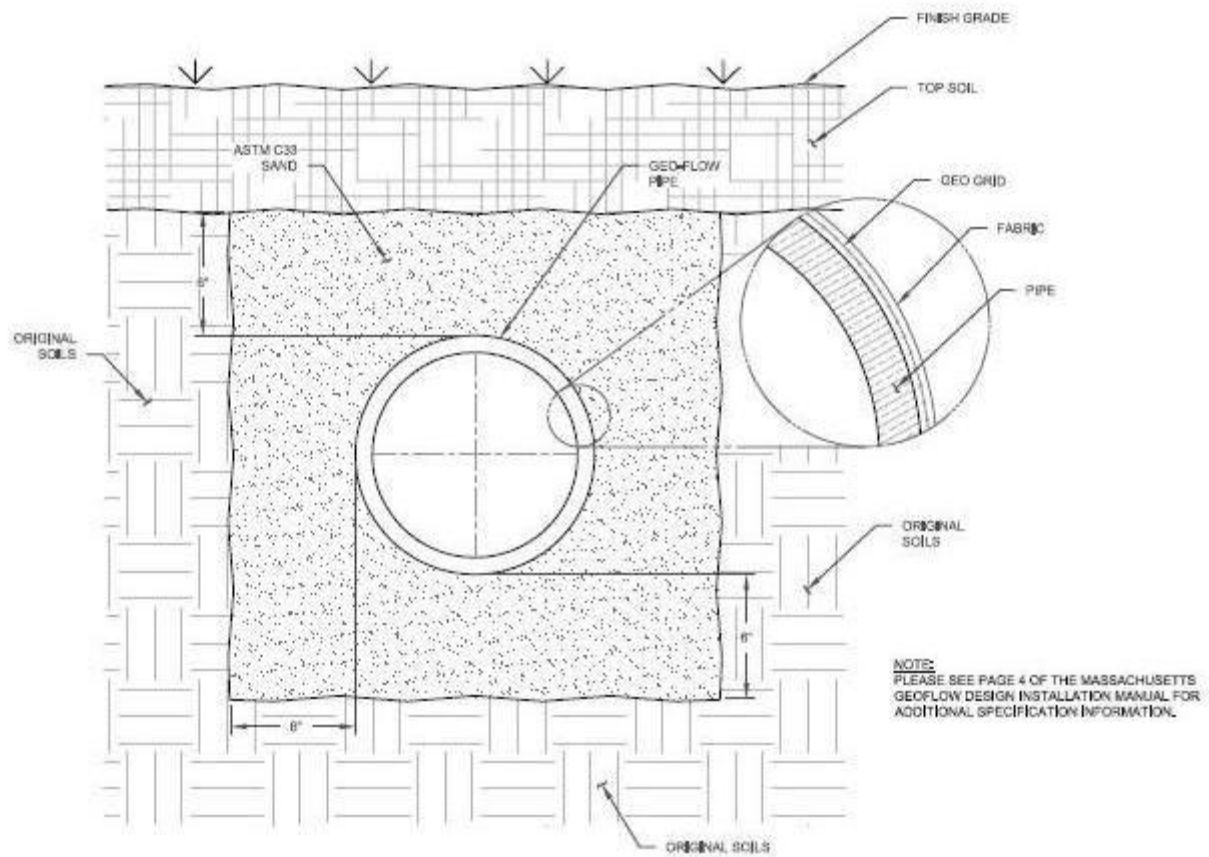
Tensile Warp: 52 lb. min.; FTM NW505

Tensile Fill: 68 lb. min.

System Sand:

“System sand” shall meet ASTM C-33 (concrete sand) requirements.

IV. ADS GEO-FLOW PIPE LEACHING SYSTEM SCHEMATIC



V. BASIC DESIGN CONSIDERATIONS

GEO-flow Pipe may be used in almost any design configuration imaginable. The system allows great design flexibility in the length, width, slope, and shape of effluent disposal systems.

General Considerations:

Common design practices shall apply. These include, but are not limited to:

- product should be designed to be installed on a level plane;
- product should be designed to run parallel to contours where possible;
- longer (rather than shorter) product lines are recommended; minimum and maximum lengths shall be designed in accordance with 310 CMR 15.000;
- the outlet of the septic tank shall be at least 2 inches above the highest invert any GEO-flow Pipe line in the system.

VI. MASSACHUSETTS STATE-SPECIFIC CONSIDERATIONS

Cover Requirements: The minimum depth of cover for each GEO-flow Pipe System is ten inches (10"), comprised of six inches (6") of system sand plus a minimum of four inches (4") of cover material. Maximum cover is 96 inches.

GEO-flow Pipe is not intended for use below traffic-bearing, paved or unpaved surfaces. Construction equipment shall be kept off the top of any system. In the event that light construction equipment must travel (not operate) over the top of the system, 18 inches of well compacted, clean fill material must be placed over the top of the pipe. The surface must also be dry and stable, not saturated and susceptible to rutting.

Please contact the manufacturer for possible variance in the event that site conditions fall outside the parameters outlined above.

Venting Requirements: All GEO-flow Systems shall be vented. Vent manifolds may be used to connect multiple vents to one vent outlet.

Distribution Boxes: All systems shall include a distribution box - including serial distribution applications.

Inspection Ports: All systems shall include observation ports. D-boxes may be utilized as inspection ports.

VI. MASSACHUSETTS STATE-SPECIFIC CONSIDERATIONS (CONTINUED)

Installer & Designer Certification: Approval of the GEO-flow Pipe Leaching System in Massachusetts includes a requirement that all installers and designers of the GEO-flow Pipe Leaching System be trained and certified in its use by a certified ADS/Hancor representative. Until designers and installers are certified, all designs and installations must be approved and/or inspected by a representative of the manufacturer.

“System Installation Report Form”: Certified installers must complete a “GEO-flow Pipe Leaching System Installation Report Form” for each system installed, and submit this completed form to ADS. Please see a copy of this form, with instructions, at the back of this manual, labeled “Appendix I”.

“System Operation Manual”: Certified designers must provide the system owner with a copy of the “GEO-flow Pipe Leaching System Operation Manual” at the time of system purchase. Please see a copy of this document at the back of this manual, labeled “Appendix II”.

“Technology Checklist”: Certified designers must provide the system owner with a copy of the “GEO-flow Pipe Leaching System Technology Checklist” at the time of system purchase. Please see a copy of this document at the back of this manual, labeled “Appendix III”.

Load Limits: Each GEO-flow Pipe Leaching System line shall have a maximum design flow of 500 gallons per day.

Line Lengths: Each single line of GEO-flow shall be no longer than 100 linear feet and no less than 30 linear feet.

Separation Distances: Vertical and horizontal setback distances are measured from the outer aspect of the system sand.

Percolation Rates: General use approval allows for the installation of the GEO-flow Pipe Leaching System on sites with percolation rates up to 60 minutes per inch. Remedial use approval allows for the installation on sites with percolation rates up to 90 minutes per inch.

Reserve Area: In new construction applications, the system must include a reserve area the size of a conventional Title 5 soil absorption system using aggregate. For remedial applications, systems may be installed without full reserve area in those cases where the owner can demonstrate that such area is not available.

Note:

Any and all information in this manual is to be used in conjunction with the Massachusetts Department of Environmental Protection (DEP) rules, including but not limited to 310 CMR 15.000, and all other State and local regulations.

VII. SYSTEM SAND SPECIFICATIONS

All GEO-flow Pipe Leaching Systems installed in Massachusetts require a minimum of six inches (6") of "system sand" surrounding the entire circumference of the pipe.

"System Sand": "System sand" shall meet ASTM C-33 (concrete sand) requirements.

Surrounding Backfill Material: Material around the remainder of the system may be either additional system sand or material that meets the requirements of 310 CMR 15.255(3).

Bed Material: Beds which slope 10% or less require the system sand area to extend a minimum of one foot (1') around the perimeter of the GEO-flow pipe bed. Beds which slope more than 10% require the system sand area to extend a minimum of one foot (1') around the GEO-flow pipe, and an additional six inches (6") of system sand, measured from the bottom of the GEO-flow pipe, must extend 3' on the downward side. [See Section XII, pp. 23-32.]

Fill Extensions: Raised systems that include a slope of 10% or less require three-foot (3') extensions on each side (including system sand, surrounding sand, and topsoil) before tapering. Raised systems that include a slope of greater than 10% require three-foot (3') extensions on three (3) sides and a five-foot (5') extension on the down slope side before tapering. Tapering shall be 3:1 or less. [See Section XII, pp. 29-30.]

All mounded systems shall be designed and installed in accordance with 310 CMR 15.255.

VIII. STANDARD SYSTEM CONSIDERATIONS

Minimum Area: The minimum area for a GEO-flow Pipe Leaching System installed for new construction shall be 400 square feet.

Maximum Slope of Site: Maximum slope of site shall be 3:1 (33%).

Maximum Sand Bed Slope: Maximum sand bed slope for all systems shall be 25%.

Setback Requirements: A minimum horizontal separation of 15 feet shall be maintained between any naturally occurring downhill slope which is not greater than 3:1 and the GEO-flow Pipe Leaching System. This distance shall be measured from the outer aspect of the top of the system sand and the adjacent downhill slope.

All GEO-flow Leaching Pipe Systems shall meet the setback and separation distance requirements of 310 CMR 15.000.

IX. SIZING THE GEO-flow PIPE SYSTEM: UP TO 60 MIN/IN

Step 1: Determine the amount of linear feet of GEO-flow pipe required.

Using the percolation rate and the number of bedrooms (or Commercial GPD) in Table I below to determine the amount of linear feet of GEO-flow pipe required:

Table I						
Number of Bedrooms						
Perc Rate Min/In	2	3	4	5	6	Commercial Per 100 GPD
1-9	100	150	200	250	300	50
10-13	110	165	220	275	330	55
14-19	120	180	240	300	360	60
20-30	130	165	260	325	390	65
31-40	140	210	280	350	420	70
41-50	150	225	300	375	450	75
51-60	160	240	320	400	480	80

Example: A four (4) bedroom home on a site with a percolation rate of 16 minutes per inch requires 240 feet of GEO-flow pipe.

Step 2: Determine the percentage of slope on the proposed system.

Note: The maximum slope for a single level GEO-flow Pipe system is 25%. However, the site slope may be greater if fill is used to keep the system slope within the maximum.

If you know the percentage of slope on the proposed system, skip this step (#2) and proceed to Step 3.

If you do not know the percentage of slope on the proposed system, follow the procedure below to determine the percentage of system slope:

- identify the highest elevation of the proposed location.
- identify the lowest elevation of the proposed location.
- subtract the lowest elevation from the highest elevation. This gives you the elevation change.
- measure the horizontal distance between the two elevations. This gives you the horizontal length.

IX. SIZING THE GEO-flow PIPE SYSTEM - UP TO 60 MIN/IN (cont)

- e. Divide the elevation change by the horizontal length and multiply by 100 to calculate the percentage of slope on the website
- f. choose a percentage of slope to be used for the system. (Note: The system slope does not need to be the same as the site slope.)
- g. go to step 4.

Step 3: Determine the minimum center-to-center pipe spacing.

Use the percolation rate and the percentage of system slope in Table II below to determine the required minimum center-to-center product spacing (in feet).

Table II

Percent Slope	Spacing in feet					
	1-10	11-20	21-30	31-40	41-50	51-60
0-10%	1.5'	1.5'	1.75'	2.00	2.5'	3.0'
11-15 %	1.5'	1.75'	2.0'	2.25	2.75'	3.25'
16-20%	1.75'	2.0'	2.25'	2.50	3.0'	3.5'
21-25 %	2.0'	2.25'	2.75'	3.00	3.25'	3.75'

To determine the appropriate drop between lines of GEO-flow Pipe , refer to the Center-to-Center Pipe Spacing Chart below

Center-to-Center Pipe Spacing Chart

Percent Slope:		1.0%	2.0%	3.0%	4.0%	5.0%	6.0%	7.0%	8.0%	9.0%	10%	11%	12%	13%
PIPE SPACING CENTER-TO-CENTER (feet)	4.00	0.040	0.080	0.120	0.160	0.200	0.240	0.280	0.320	0.360	0.400	0.440	0.480	0.520
	3.75	0.038	0.075	0.113	0.150	0.188	0.225	0.263	0.300	0.338	0.375	0.413	0.450	0.488
	3.50	0.035	0.070	0.105	0.140	0.175	0.210	0.245	0.280	0.315	0.350	0.385	0.420	0.455
	3.25	0.033	0.065	0.098	0.130	0.163	0.195	0.228	0.260	0.293	0.325	0.358	0.390	0.423
	3.00	0.030	0.060	0.090	0.120	0.150	0.180	0.210	0.240	0.270	0.300	0.330	0.360	0.390
	2.75	0.028	0.055	0.083	0.110	0.138	0.165	0.193	0.220	0.248	0.275	0.303	0.330	0.358
	2.50	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200	0.225	0.250	0.275	0.300	0.325
	2.25	0.023	0.045	0.068	0.090	0.113	0.135	0.158	0.180	0.203	0.225	0.248	0.270	0.293
	2.00	0.020	0.040	0.060	0.080	0.100	0.120	0.140	0.160	0.180	0.200	0.220	0.240	0.260
	1.75	0.018	0.035	0.053	0.070	0.088	0.105	0.123	0.140	0.158	0.175			
	1.50	0.015	0.030	0.045	0.060	0.075								
		DROP BETWEEN LINES OF GEO-FLOW PIPE FOR A PARTICULAR PIPE SPACING (Feet)												
		0.01	0.020	0.030	0.040	0.050	0.060	0.070	0.080	0.090	0.100	0.110	0.120	0.130

Percent Slope:		14%	15%	16%	17%	18%	19%	20%	21%	22%	23%	24%	25%
PIPE SPACING CENTER-TO-CENTER (feet)	4.00	0.520	0.560	0.600	0.680	0.720	0.760	0.800	0.840	0.880	0.920	0.960	1.000
	3.75	0.488	0.525	0.563	0.638	0.675	0.713	0.750	0.788	0.825	0.863	0.900	0.938
	3.50	0.455	0.490	0.525	0.595	0.630	0.665	0.700	0.735	0.770	0.805	0.840	0.875
	3.25	0.423	0.455	0.488	0.553	0.585	0.618	0.650	0.683	0.715	0.748	0.780	0.813
	3.00	0.390	0.420	0.450	0.510	0.540	0.570	0.600	0.630	0.660	0.690	0.720	0.750
	2.75	0.358	0.385	0.413	0.468	0.495	0.523	0.550	0.578	0.605	0.633	0.660	0.688
	2.50	0.325	0.350	0.375	0.425	0.450	0.475	0.500	0.525	0.550	0.575	0.600	0.625
	2.25	0.293	0.315	0.338	0.383	0.405	0.428	0.450					
	2.00	0.260	0.280	0.300									
	1.75												
		DROP BETWEEN LINES OF GEO-FLOW PIPE FOR A PARTICULAR PIPE SPACING											
		0.14	0.15	0.16	0.17	0.18	0.19	0.2	0.21	0.22	0.23	0.24	0.25

IX. SIZING THE GEO-flow PIPE SYSTEM - UP TO 60 MIN/IN (cont)

Step 4: Calculate the total system area

All GEO-flow Pipe Leaching Systems installed in Massachusetts must be (1) a minimum of 400 square feet in total area and (2) at least 60% the size of a conventional pipe and aggregate system for the same site.

1. Using Tables I and II, determine the layout of the system (W x L).
2. Add two feet (2') to the layout width (W) and two feet (2') to the layout length (L). For sloping systems greater than 10%, add five feet (5') to the system width (W) and 2 feet (2') to the system length (L).
3. Multiply resulting numbers to calculate sand bed area in square feet.

Table III below cites the minimum sand bed area requirements in square feet for Massachusetts. Cross reference your calculation from step 3 with Table III. If the area you have calculated is less than the minimum cited in this table, go to step 5 (next page).

Table III

Perc Rate Min/ Inch	2 BR 220 GPD				3 BR 330 GPD				4 BR 440 GPD			
	SOIL CLASS				SOIL CLASS				SOIL CLASS			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
1-5	400	400			400	400			400	440		
6	400	400			400	400			400	440		
7	400	400			400	400			400	440		
8	400	400			400	400			400	440		
10		400				400				440		
15		400	400			400	525			471	714	
20		400	400			400	582			498	776	
25		400	400			495	600			660	800	
30		400	455			600	683			800	910	
40			528				792				1056	
50			660	660			990	990			1320	1320
60			880	880			1320	1320			1760	1760

IX. SIZING THE GEO-flow PIPE SYSTEM - UP TO 60 MIN/IN (cont)

Step 4: Calculate the total system area (cont.)

**Table III
(cont).**

Perc Rate Min/ Inch	5 BR 550 GPD				6 BR 660 GPD				Commercial per 100 GPD			
	SOIL CLASS				SOIL CLASS				SOIL CLASS			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
1-5	446	550			535	660			81	100		
6	471	550			566	660			86	100		
7	485	550			582	660			88	100		
8	500	550			600	660			91	100		
10		550				660				100		
15		589	892			707	1070			107	162	
20		623	971			747	1165			113	176	
25		825	1000			990	1200			150	182	
30		1000	1138			1200	1366			182	207	
40			1320				1584				240	
50			1650	1650			1980	1980			300	300
60			2200	2200			2640	2640			400	400

Step 5: Increasing sand bed size to meet minimum requirements

If your calculations indicate that the minimum sand bed area sizing requirements are not met, you can increase the size of the footprint by either (1) increasing the width of the bed or (2) increasing the length of the GEO-flow lines. In certain instances increasing the Center-to-center spacing a small amount will provide adequate area.

X. SIZING THE GEO-flow PIPE SYSTEM: 61—90 MIN/IN

System Requirements: Serial distribution is required for all systems in soils with perc rates between 61-90 MPI. Systems with flows greater than 500 GPD must be divided into multiple beds. No bed may be designed to accept greater than 500 GPD.

Maximum percentage of slope allowed: Maximum percentage of slope allowed for 61-70 MPI soils is 15%. Maximum percentage of slope allowed for 71-90 MPI soils is 10%.

Additional sand requirement: An additional 12 inches of system sand must be installed below the entire design area of the system as well as any extension areas, parallel to the contour of the site, prior to installation of the GEO-flow Pipe Leaching System in soils between 61 and 90 MPI.

Cutting the GEO-flow pipe product: The GEO-flow pipe product should not be cut unless necessary. Every effort should be made to keep line lengths in ten foot (10') increments.

Step 1: Determine the percentage of slope on the proposed system.

Note: The maximum slope for a single level GEO-flow Pipe system is 15%. However, the site slope may be greater if fill is used to keep the system slope within the maximum.

If you know the percentage of slope on the proposed system, skip this step (#1) and proceed to Step 2.

If you do not know the percentage of slope on the proposed system, follow the procedure below to determine the percentage of system slope:

- a. identify the highest elevation of the proposed location.
- b. identify the lowest elevation of the proposed location.
- c. subtract the lowest elevation from the highest elevation. This gives you the elevation change.
- d. measure the horizontal distance between the two elevations. This gives you the horizontal length.
- e. Divide the elevation change by the horizontal length and multiply by 100 to calculate the percentage of slope on the website
- f. choose a percentage of slope to be used for the system. (Note: The system slope does not need to be the same as the site slope.)
- g. go to step 4.

Step 2: Determine the appropriate sizing table.

Sizing tables for systems in soils with percolation rates between 61 and 90 MPI are on pages 13-18. Select the appropriate sizing table using the **number of bedrooms** (or flow in GPD for commercial installations).

System size is the total square footage of sand bed area required. Sand bed area may be designed as one or more than one individual sand bed. All sand beds are either six, nine or 12 feet (6', 9' or 12') wide.

Step 3: Determine the bed widths and lengths.

Using the appropriate sizing table (pages 12-15) determine the number of beds, and sizes of each bed, as follows:

- A. In the left hand column (Perc. Rate/Slope), find the rows that meet the percolation rate and slope for the site. There should be more than one (1) row that describes the site.
- B. In the next column (Min. Bed Length), select the longest bed length that your site will accommodate. If the longest bed length exceeds 102 linear feet, design the system with multiple beds of equal length.

Step 4. Design the system.

Design the beds as required, utilizing two, three or four (2, 3 or 4) lines of GEO-flow pipe in each bed as determined by the design bed width. Note: Pipe is designed one foot (1') from the end of the sand bed.

Table IV. Total Footage versus Actual Length of Pipe

Bed Width	Number of Pipe Lines	Bed Length	32	37	42	47	52	57	62	67
		Pipe Length	30	35	40	45	50	55	60	65
6'	2	Total Pipe Ftg.	60	70	80	90	100	110	120	130
9'	3	Total Pipe Ftg.	90	105	120	135	150	165	180	195
12'	4	Total Pipe Ftg.	120	140	160	180	200	220	240	260

Bed Width	Number of Pipe Lines	Bed Length	72	77	82	87	92	97	102
		Pipe Length	70	75	80	85	90	95	100
6'	2	Total Pipe Ftg.	140	150	160	170	180	190	200
9'	3	Total Pipe Ftg.	210	225	240	255	270	285	300
12'	4	Total Pipe Ftg.	280	300	320	340	360	380	400

Step 5. Verify that the system meets minimum size requirements.

The GEO-flow Pipe Leaching System approval requires that every GEO-flow system must be at least 60% of the area that would be required for a conventional pipe and aggregate system on the same site, including remedial systems in soils with percolation rates of between 61 and 90 MPI.

Table V below cites the minimum sand bed area required in the State of Massachusetts.

Table V

Perc. Rate MPI	2 BR	3 BR	4 BR	5 BR	Add'l BR	Commercial Per 100 GPD
61-90	880	1320	1760	2200	440	400

Example/Calculation:

Start with your GEO-flow system design, actual sand bed area. This has been determined previously from the system design parameters: perc rate, number of bedrooms, and percentage of slope. Assume the design is for a 3 BR house in 65 MPI soils on a 4% slope. From our chart on Page 14, this example calls for a minimum sand bed area of 784 square feet, using a 131' bed length and a six foot (6') bed width. This example system would be comprised of two (2) sand beds, each 65.5' long and six feet (6') wide. The pipe length would be 63.5 feet, as the one foot (1') extension is included in the area on both ends. This system is therefore 720 square feet in total bed area ($6 \times 63.5 = 381.5 \times 2 = 762$).

From Table V, we see that the State requirement is for 1320 square feet. Multiply the required area by .6 to determine minimum square footage of GEO-flow required. $1320 \times .6 = 790$. We need to add an additional 28 square feet of sand bed area.

If we keep the GEO-flow pipe at 10 foot lengths, each row would be 70 feet long. Each bed would thus be $70 \times 6 = 420$, $\times 2 = 840$.

X. SIZING THE GEO-flow PIPE SYSTEM: 61—90 MIN/IN

Table VI. 2 Bedroom

Perc. Rate/ Slope	Sand Bed Area (sq.ft.)	Sand Bed Width	Number Of Lines	Ctr. To Ctr. Spacing	Min. Bed Length
61-70 / 0%<5%	523	12'	4	3'	44'
61-70 / 0%<5%	523	9'	3	3'	58'
61-70 / 0%<5%	523	6'	2	3'	87'
61-70 / 5%<10%	601	12'	4	1.5'	50'
61-70 / 5%<10%	601	9'	3	1.5'	67'
61-70 / 5%<10%	601	6'	2	1.5'	100'
61-70 / 10%<15%	628	12'	4	1.5'	53'
61-70 / 10%<15%	628	9'	3	1.5'	73'
71-80 / 0%<5%	559	12'	4	3'	47'
71-80 / 0%<5%	559	9'	3	3'	62'
71-80 / 0%<5%	559	6'	2	3'	93'
71-80 / 5%<10%	643	12'	4	1.5'	54'
71-80 / 5%<10%	643	9'	3	1.5'	71'
71-80 / 5%<10%	643	6'	2	1.5'	107'
81-90 / 0%<5%	602	9'	3	3'	67'
81-90 / 0%<5%	602	6'	2	3'	100'
81-90 / 5%<10%	690	9'	3	1.5'	77'
81-90 / 5%<10%	692	6'	2	1.5'	115'

X. SIZING THE GEO-flow PIPE SYSTEM: 61—90 MIN/IN

Table VII. 3 Bedroom

Perc. Rate/ Slope	Sand Bed Area (sq.ft.)	Sand Bed Width	Number Of Lines	Ctr. To Ctr. Spacing	Min. Bed Length
61-70 / 0%<5%	784	12'	4	3'	65'
61-70 / 0%<5%	784	9'	3	3'	87'
61-70 / 0%<5%	784	6'	2	3'	131'
61-70 / 5%<10%	902	12'	4	1.5'	75'
61-70 / 5%<10%	902	9'	3	1.5'	100'
61-70 / 5%<10%	902	6'	2	1.5'	150'
61-70 / 10% <15%	941	12'	4	1.5'	78'
61-70 / 10% <15%	941	9'	3	1.5'	105'
71-80 / 0%<5%	839	12'	4	3'	70'
71-80 / 0%<5%	839	9'	3	3'	93'
71-80 / 0%<5%	839	6'	2	3'	140'
71-80 / 5%<10%	965	12'	4	1.5'	80'
71-80 / 5%<10%	965	9'	3	1.5'	107'
71-80 / 5%<10%	965	6'	2	1.5'	161'
81-90 / 0%<5%	902	9'	3	3'	100'
81-90 / 0%<5%	902	6'	2	3'	150'
81-90 / 5%<10%	1038	9'	3	1.5'	115'
81-90 / 5%<10%	1038	6'	2	1.5'	173'

X. SIZING THE GEO-flow PIPE SYSTEM: 61—90 MIN/IN

Table VIII. 4 Bedroom

Perc. Rate/ Slope	Sand Bed Area (sq.ft.)	Sand Bed Width	Number Of Lines	Ctr. To Ctr. Spacing	Min. Bed Length
61-70 / 0%<5%	1046	12'	4	3'	88'
61-70 / 0%<5%	1046	9'	3	3'	116'
61-70 / 0%<5%	1046	6'	2	3'	174'
61-70 / 5%<10%	1203	12'	4	1.5'	101'
61-70 / 5%<10%	1203	9'	3	1.5'	134'
61-70 / 5%<10%	1203	6'	2	1.5'	201'
61-70 / 10%<15%	1255	12'	4	1.5'	105'
61-70 / 10%<15%	1255	9'	3	1.5'	139'
71-80 / 0%<5%	1118	12'	4	3'	94'
71-80 / 0%<5%	1118	9'	3	3'	124'
71-80 / 0%<5%	1118	6'	2	3'	186'
71-80 / 5%<10%	1286	12'	4	1.5'	108'
71-80 / 5%<10%	1286	9'	3	1.5'	143'
71-80 / 5%<10%	1286	6'	2	1.5'	214'
81-90 / 0%<5%	1203	9'	3	3'	134'
81-90 / 0%<5%	1203	6'	2	3'	201'
81-90 / 5%<10%	1383	9'	3	1.5'	154'
81-90 / 5%<10%	1383	6'	2	1.5'	231'

X. SIZING THE GEO-flow PIPE SYSTEM: 61—90 MIN/IN

Table IX. 5 Bedroom

Perc. Rate/ Slope	Sand Bed Area (sq.ft.)	Sand Bed Width	Number Of Lines	Ctr. To Ctr. Spacing	Min. Bed Length
61-70 / 0%<5%	1307	12'	4	3'	109'
61-70 / 0%<5%	1307	9'	3	3'	145'
61-70 / 0%<5%	1307	6'	2	3'	218'
61-70 / 5%<10%	1503	12'	4	1.5'	126'
61-70 / 5%<10%	1503	9'	3	1.5'	167'
61-70 / 5%<10%	1503	6'	2	1.5'	251'
61-70 / 10%<15%	1568	12'	4	1.5'	131'
61-70 / 10%<15%	1568	9'	3	1.5'	174'
71-80 / 0%<5%	1398	12'	4	3'	117'
71-80 / 0%<5%	1398	9'	3	3'	155'
71-80 / 0%<5%	1398	6'	2	3'	233'
71-80 / 5%<10%	1608	12'	4	1.5'	134'
71-80 / 5%<10%	1608	9'	3	1.5'	179'
71-80 / 5%<10%	1608	6'	2	1.5'	268'
81-90 / 0%<5%	1504	9'	3	3'	168'
81-90 / 0%<5%	1504	6'	2	3'	251'
81-90 / 5%<10%	1730	9'	3	1.5'	193'
81-90 / 5%<10%	1730	6'	2	1.5'	288'

X. SIZING THE GEO-flow PIPE SYSTEM: 61—90 MIN/IN

Table X. Additional Bedroom

Perc. Rate/ Slope	Sand Bed Area (sq.ft.)	Sand Bed Width	Number Of Lines	Ctr. To Ctr. Spacing	Min. Bed Length
61-70 / 0%<5%	261	12'	4	3'	22'
61-70 / 0%<5%	261	9'	3	3'	29'
61-70 / 0%<5%	261	6'	2	3'	44'
61-70 / 5%<10%	300	12'	4	1.5'	25'
61-70 / 5%<10%	300	9'	3	1.5'	33'
61-70 / 5%<10%	300	6'	2	1.5'	50'
61-70 / 10%<15%	313	12'	4	1.5'	26'
61-70 / 10%<15%	313	9'	3	1.5'	35'
71-80 / 0%<5%	280	12'	4	3'	24'
71-80 / 0%<5%	280	9'	3	3'	31'
71-80 / 0%<5%	280	6'	2	3'	47'
71-80 / 5%<10%	322	12'	4	1.5'	27'
71-80 / 5%<10%	322	9'	3	1.5'	36'
71-80 / 5%<10%	322	6'	2	1.5'	54'
81-90 / 0%<5%	301	9'	3	3'	34'
81-90 / 0%<5%	301	6'	2	3'	50'
81-90 / 5%<10%	346	9'	3	1.5'	39'
81-90 / 5%<10%	346	6'	2	1.5'	58'

X. SIZING THE GEO-flow PIPE SYSTEM: 61—90 MIN/IN

Table XI. Commercial (per 100 GPD)

Perc. Rate/ Slope	Sand Bed Area (sq.ft.)	Sand Bed Width	Number Of Lines	Ctr. To Ctr. Spacing	Min. Bed Length
61-70 / 0%<5%	261	12'	4	3'	22'
61-70 / 0%<5%	261	9'	3	3'	29'
61-70 / 0%<5%	261	6'	2	3'	44'
61-70 / 5%<10%	300	12'	4	1.5'	25'
61-70 / 5%<10%	300	9'	3	1.5'	33'
61-70 / 5%<10%	300	6'	2	1.5'	50'
61-70 / 10%<15%	313	12'	4	1.5'	26'
61-70 / 10%<15%	313	9'	3	1.5'	35'
71-80 / 0%<5%	280	12'	4	3'	24'
71-80 / 0%<5%	280	9'	3	3'	31'
71-80 / 0%<5%	280	6'	2	3'	47'
71-80 / 5%<10%	322	12'	4	1.5'	27'
71-80 / 5%<10%	322	9'	3	1.5'	36'
71-80 / 5%<10%	322	6'	2	1.5'	54'
81-90 / 0%<5%	301	9'	3	3'	34'
81-90 / 0%<5%	301	6'	2	3'	50'
81-90 / 5%<10%	346	9'	3	1.5'	39'
81-90 / 5%<10%	346	6'	2	1.5'	58'

XI. INSTALLATION INSTRUCTIONS

GEO-flow Pipe is easy and convenient to install. Its lightweight design makes it easily portable, and ADS fittings make it a simple task to create a system from individual pipe lengths.

General Considerations:

Common installation practices shall apply. These include, but are not limited to:

- any smearing of the excavation should be scarified with a rake or shovel;
- each line of GEO-flow Pipe should be installed on a level plane;
- each line of GEO-flow Pipe should be installed parallel to contours where possible;
- when required, GEO-flow Pipe system sand should be installed on the same day that the disposal area is excavated.

Specific Instructions:

All configurations of GEO-flow Pipe require a minimum of 6-inches of specified “system sand” around the entire pipe. This approved “system sand” shall meet ASTM Standard C-33 (concrete sand), or the following specification:

Percentage Restrictions

35% or less of the total sand may be gravel.

40%-90% of the total sand is to be coarse and very coarse sand.

Gravel Quality Restrictions

No gravel is to exceed $\frac{3}{4}$ " in diameter.

No gravel is smaller than 2mm/.0787" in diameter. (It must not pass through a #10 sieve.)

Coarse Sand Quality Restrictions

No coarse sand is smaller than 0.5mm/.0196" in diameter. (It must not pass through a #35 sieve.)

Fines Quality Restrictions

No more than 2% of the total sand may pass through a #200 sieve.

The balance of the GEO-flow Pipe system may be backfilled with either sand fill or material that meets the requirements of 310 CMR 15.255(3).

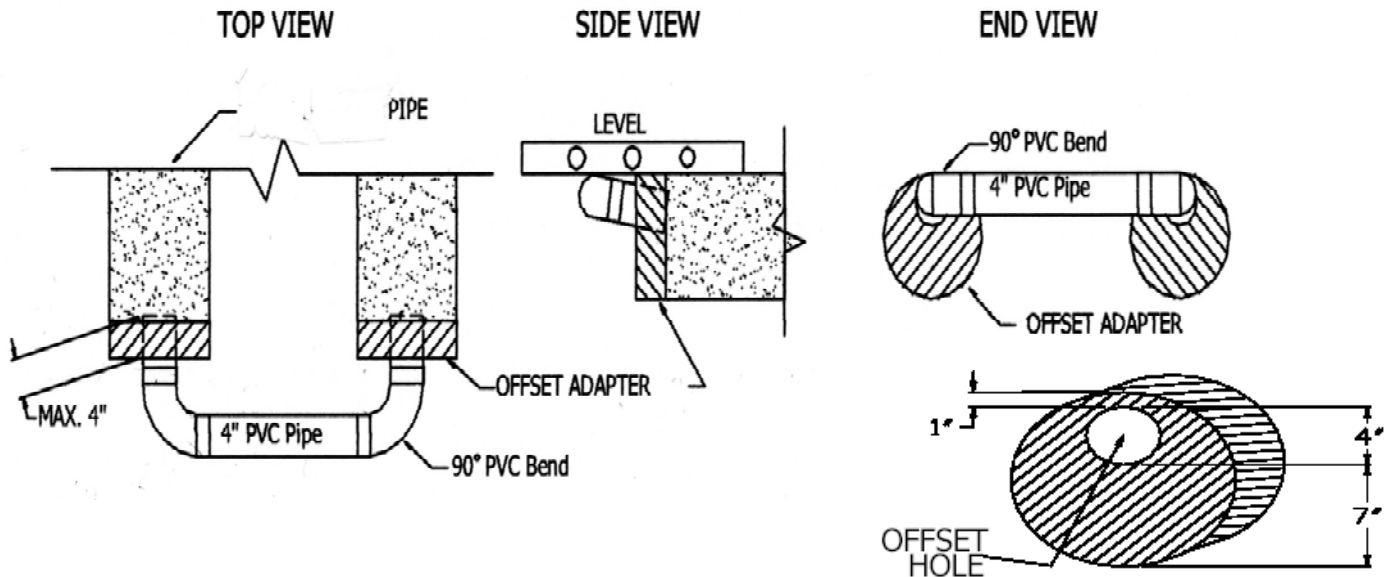
Serial Distribution:

When designing and installing GEO-flow Pipe lines in serial distribution, the use of offset adapters along with 4" PVC pipe can create a “raised connection” that will allow for more complete filling of each line before effluent flows to subsequent pipes. More complete filling maximizes total system capacity, and leads to greater exposure of the geotextile fabric, which leads to increased bacteriological activity.

XI. INSTALLATION INSTRUCTIONS (continued)

Serial Distribution, continued:

To create a “raised connection”, offset adapters are placed on the appropriate end of the GEO-flow Pipe line with the hole at 12 o'clock. A short length of 4" PVC pipe is placed no further than 4-inches through the adapter into the pipe void. A 4" PVC elbow is connected to the 4" pipe, and raised to the same level as the top of the GEO-flow Pipe. Another length of 4" PVC is connected to the elbow, to extend to the next GEO-flow Pipe line. A second “raised connection” is created at this subsequent line, and the two GEO-flow Pipe lines are then interconnected. See diagram below.



Raised connections should be properly bedded immediately following fabrication

XII. SYSTEM CONFIGURATIONS

GEO-flow Pipe systems may be designed and installed with each of the separate lines on the same plane. This application is called a Level System.

GEO-flow Pipe systems may also be designed and installed with each line, or several of the lines, on grade. This application is called a Sloped System.

In all instances, distribution must take place by way a distribution box. This includes equal distribution, individual line (serial) distribution, and pressure distribution.

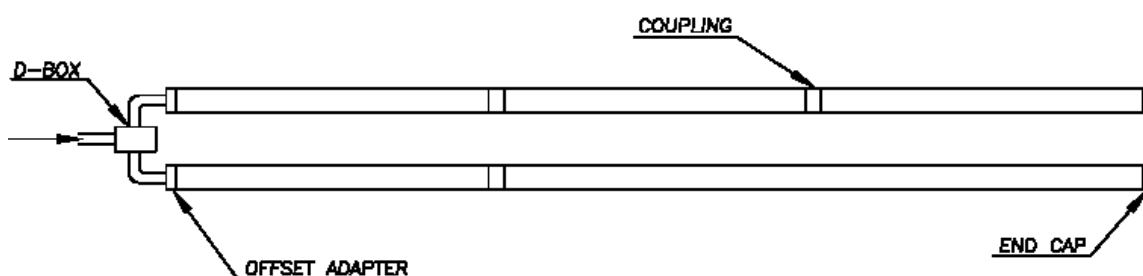
Level and Sloped Systems may be designed and installed in native soil, or partially in native soil and partially in fill material, or entirely in fill material; provided the backfill around the system is in accordance with these instructions and all state and local codes.

XII. SYSTEM CONFIGURATIONS (continued)

1. Trench Systems

The trench system is the most common effluent dispersal system. A GEO-flow Pipe trench system will be comprised of individual GEO-flow Pipe lines, with a minimum 4-foot center-to-center spacing between one line and another.

All trench systems shall include a distribution box, in accordance with 310 CMR 15.000.

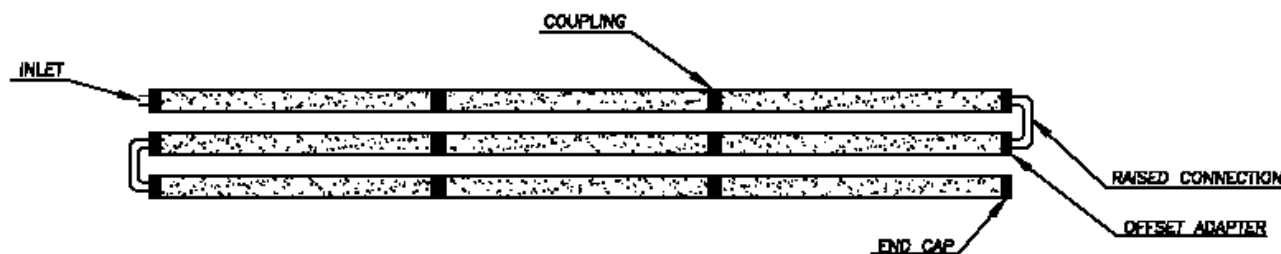


Trench System — Distribution Box

2. Serial Distribution Systems

A. Level In-Ground System

Inlet shall come from distribution box.

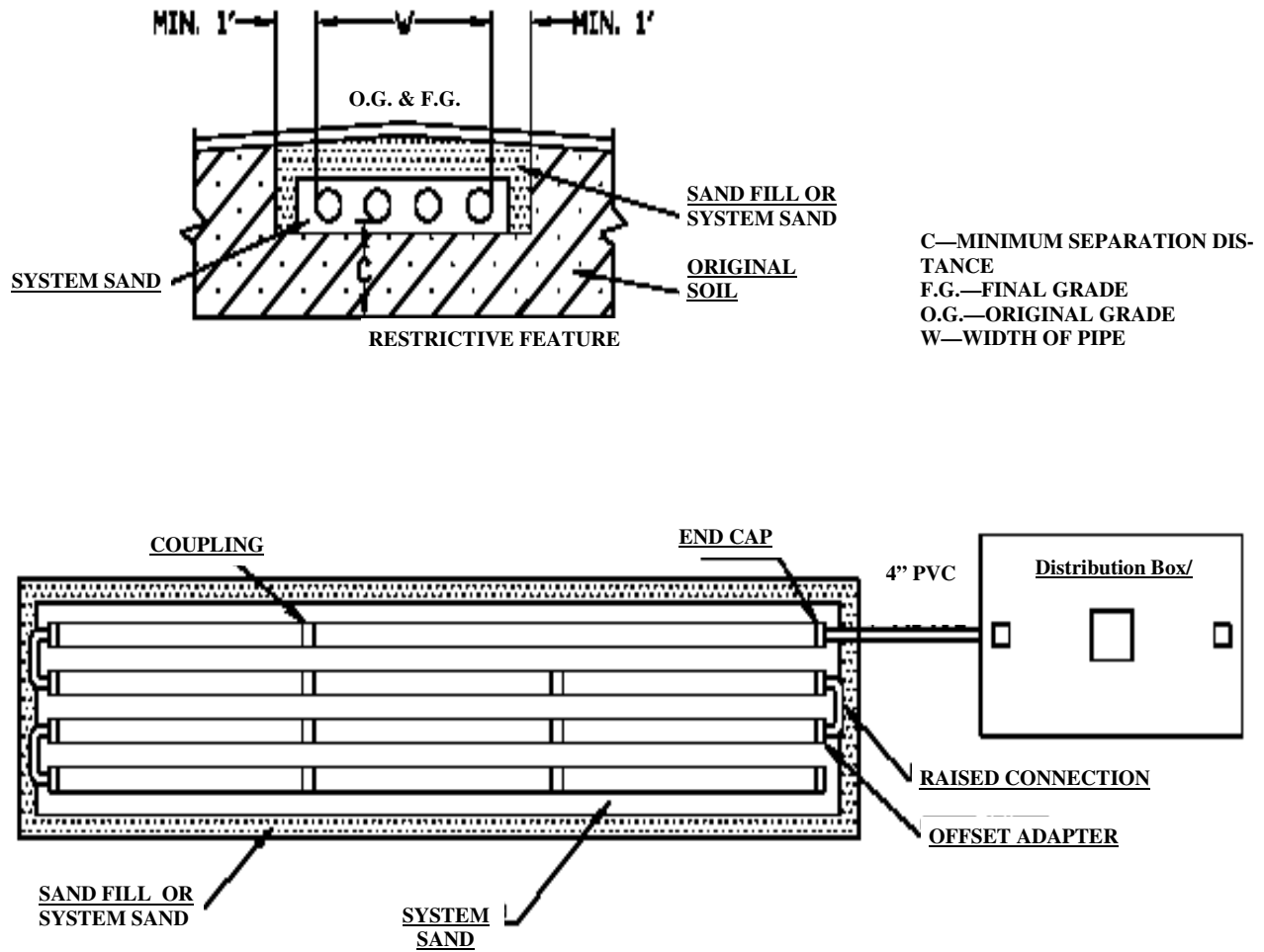


Level In-Ground System — Serial Distribution

XII. SYSTEM CONFIGURATIONS (continued)

2. Serial Distribution Systems, continued

A. Level In-Ground System — continued

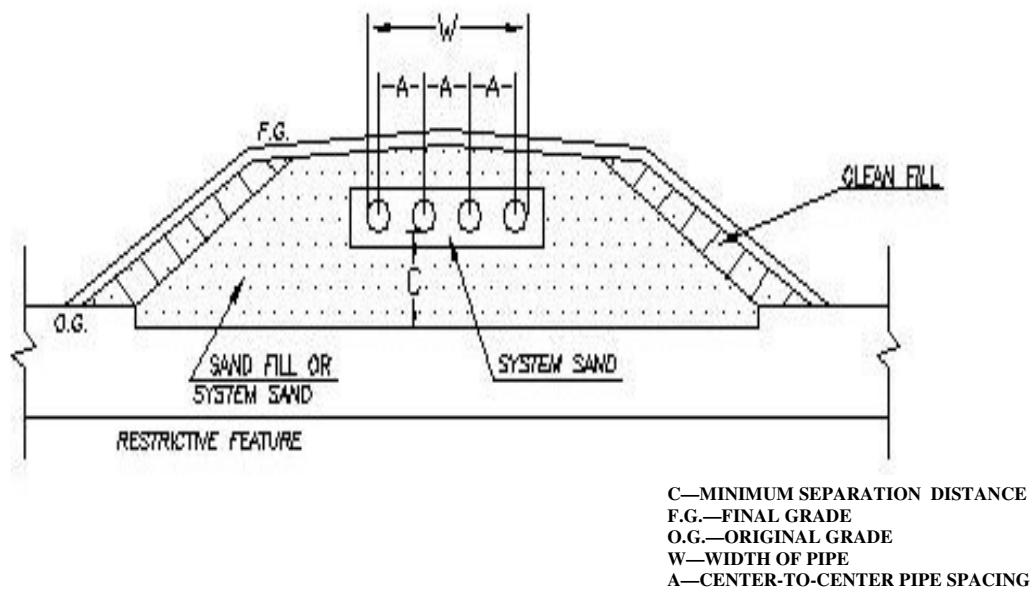


Level In-Ground System — Serial Distribution

XII. SYSTEM CONFIGURATIONS (continued)

2. Serial Distribution Systems, continued

B. Level Raised System



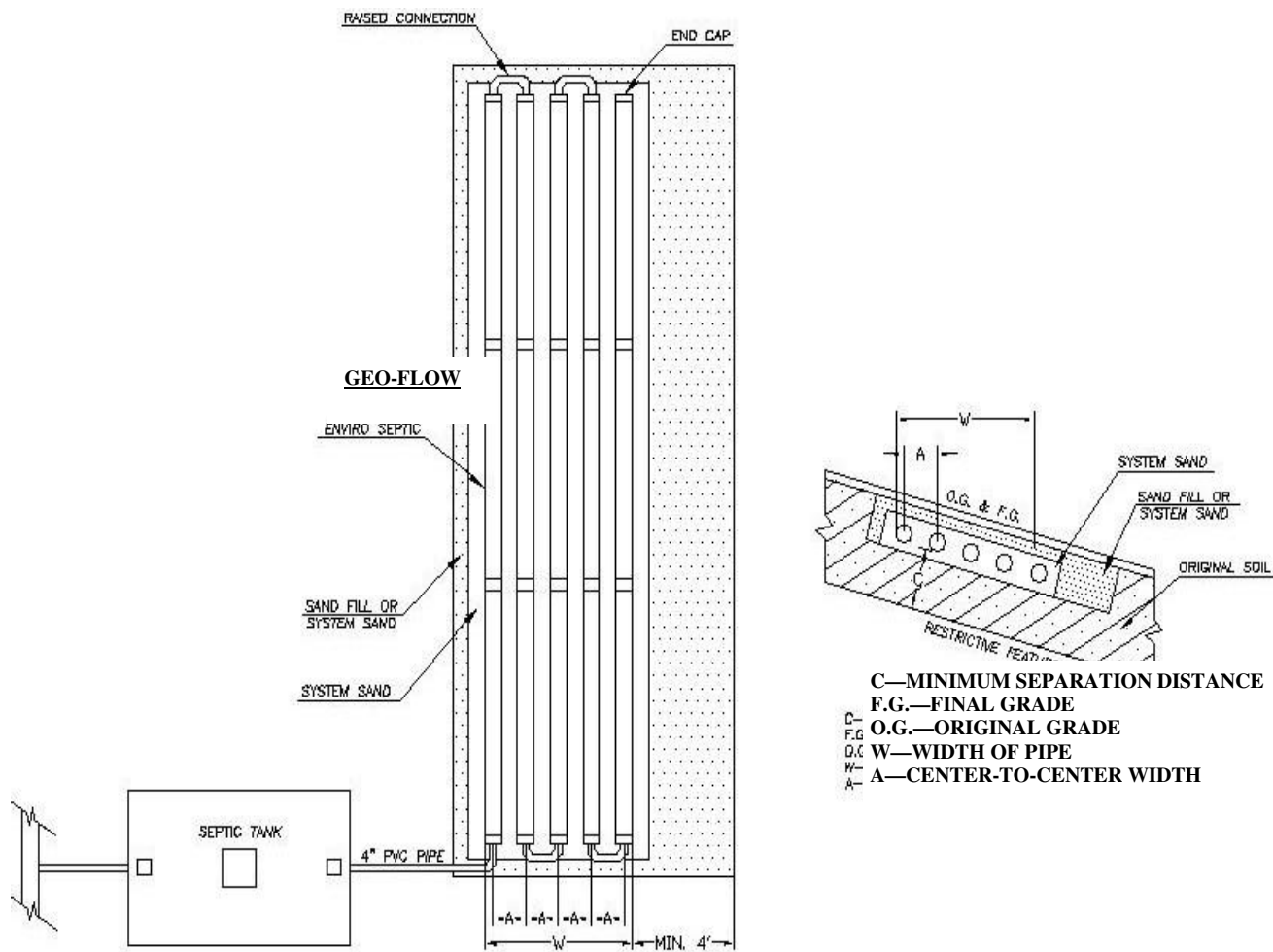
XII. SYSTEM CONFIGURATIONS (continued)

2. Serial Distribution Systems, continued

C. In-Ground Sloping System

All trench systems shall include a distribution box, in accordance with 310 CMR 15.000.

Maximum length of GEO-flow lines is 100 linear feet.

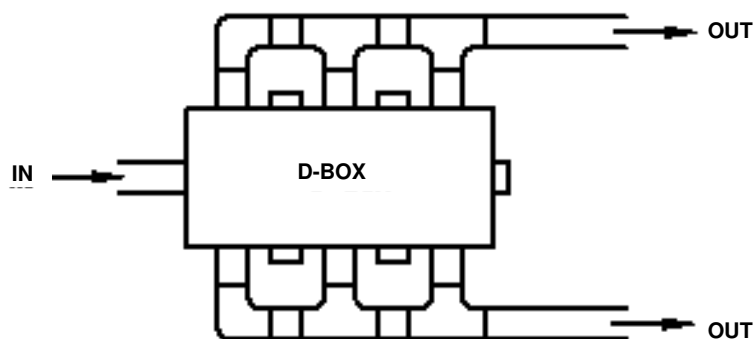
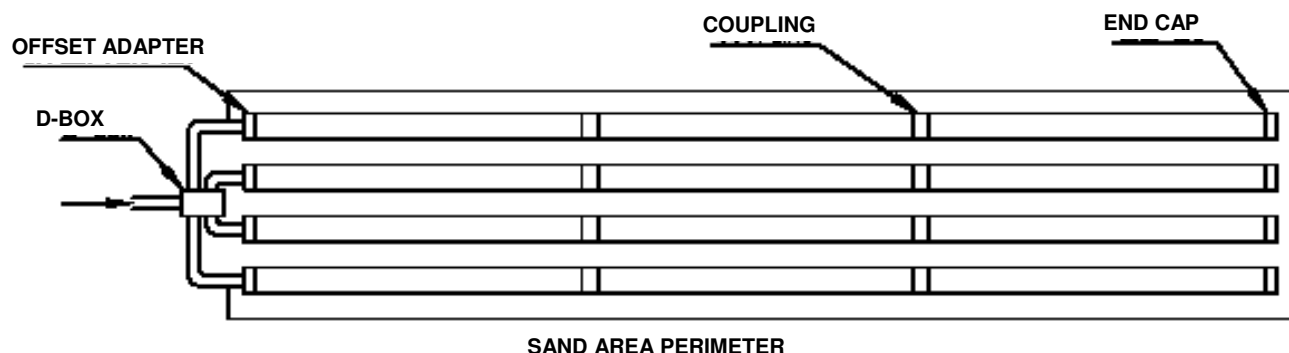


In-Ground Sloping System — Serial Distribution

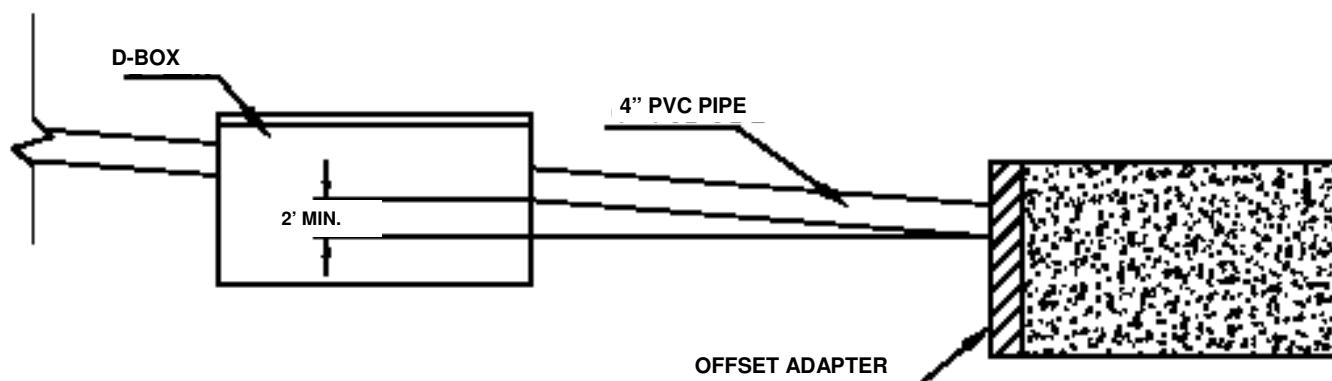
XII. SYSTEM CONFIGURATIONS (continued)

3. Distribution Box Distribution Systems

A . Level In-Ground System



NOTE: Utilizing every-other outlet will provide room for required piping and allow for easier installation

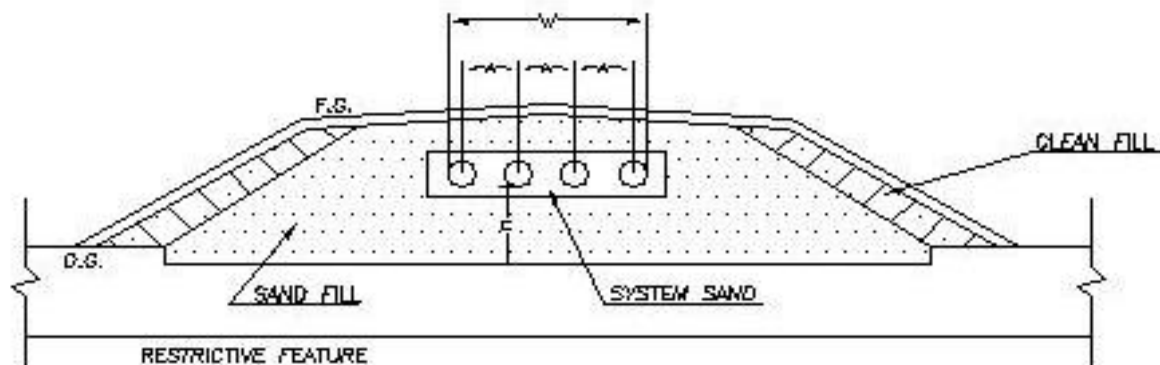


Level In-Ground System — Distribution Box Distribution

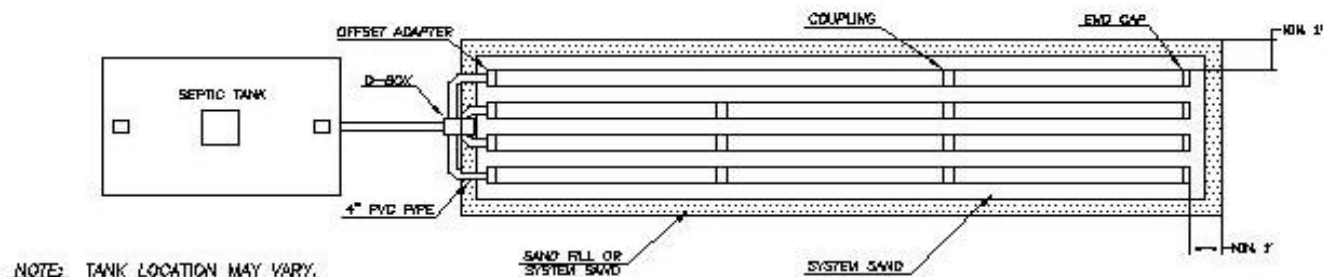
XII. SYSTEM CONFIGURATIONS (continued)

3. Distribution Box Distribution Systems

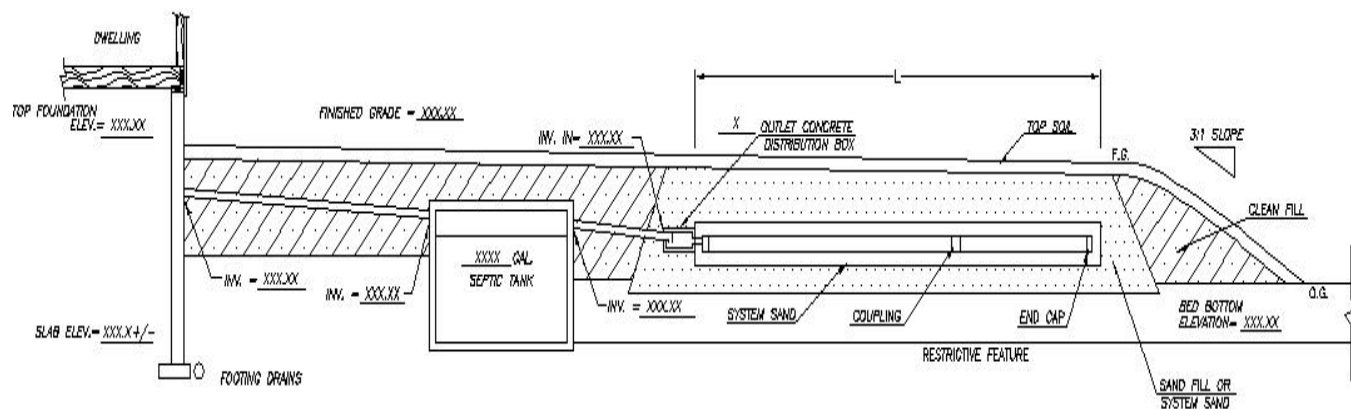
B . Level Raised System



Level Raised System — Distribution Box Distribution (end view)



Level Raised System — Distribution Box Distribution (top view)

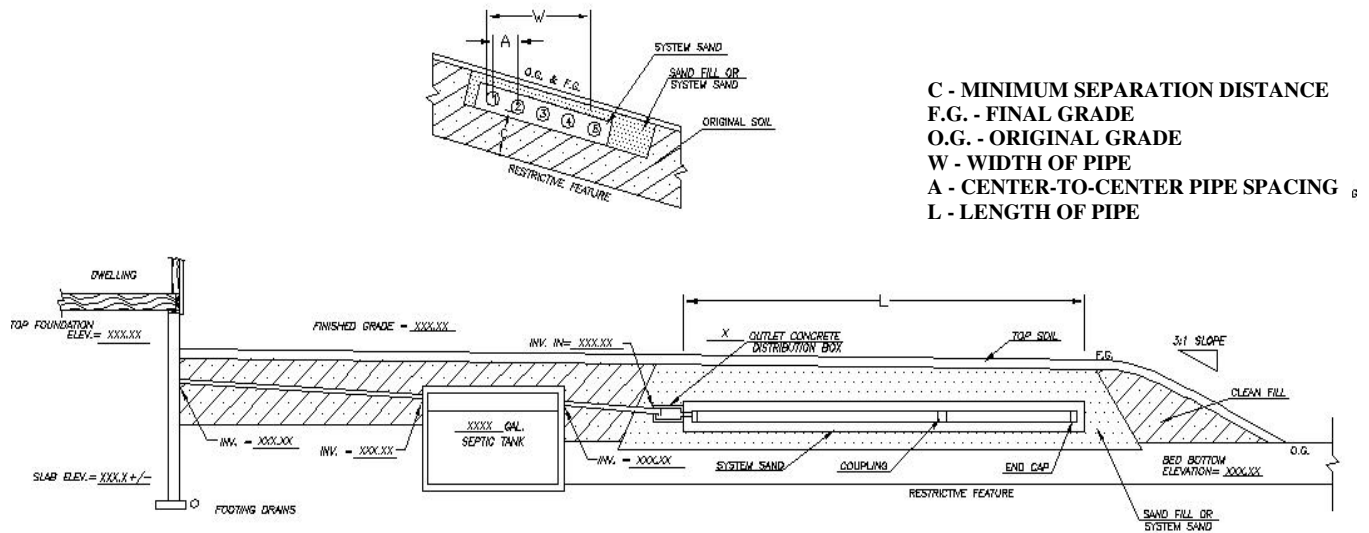


Level Raised System — Distribution Box Distribution (side view)

XII. SYSTEM CONFIGURATIONS (continued)

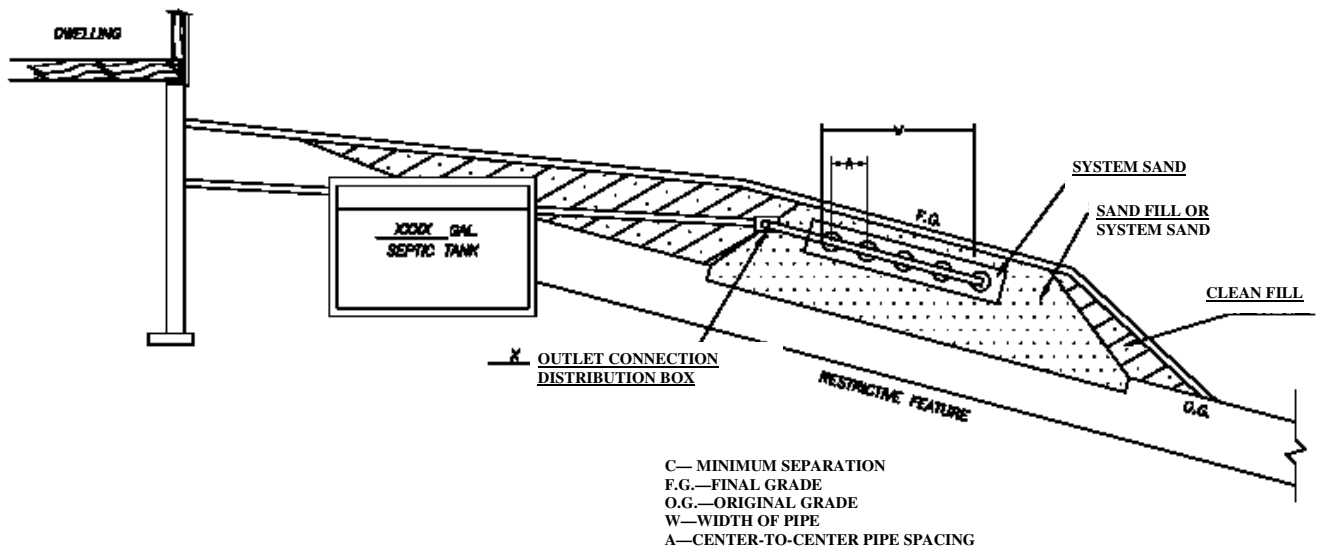
3. Distribution Box Distribution Systems

C. In-Ground Sloping System



In-Ground Sloping System — Distribution Box Distribution

D. Raised Sloping System



Raised Sloping System — Distribution Box Distribution

XII. SYSTEM CONFIGURATIONS (continued)

4. Combination Systems

GEO-flow Pipe systems may be designed and installed with the use of a combination of serial and parallel distribution. In-ground, raised, level, and sloped components may all be combined to create a specific system.

5. Non-Conventional System Configurations

Non-conventional system configurations are just that – configurations that are not of common length, width, and/or shape.

In general, GEO-flow Pipe systems should include individual lines that are at least 30-feet long and no longer than 100-feet in total length. However, with proper distribution, both shorter and longer systems may be designed and installed.

GEO-flow Pipe lines in a common system should be straight. However, site considerations intermittently call for changes in direction of the effluent disposal line. The GEO-flow Pipe system can accommodate such challenges, allowing for design and installation of curved, angled, and even nearly circular disposal lines.

In general, individual lines of GEO-flow Pipe in a non-conventional configuration system should be kept at the same length, when possible.

Contact your local ADS representative if you feel a non-conventional GEO-flow Pipe configuration could solve your site challenge.

6. Pressure Distribution

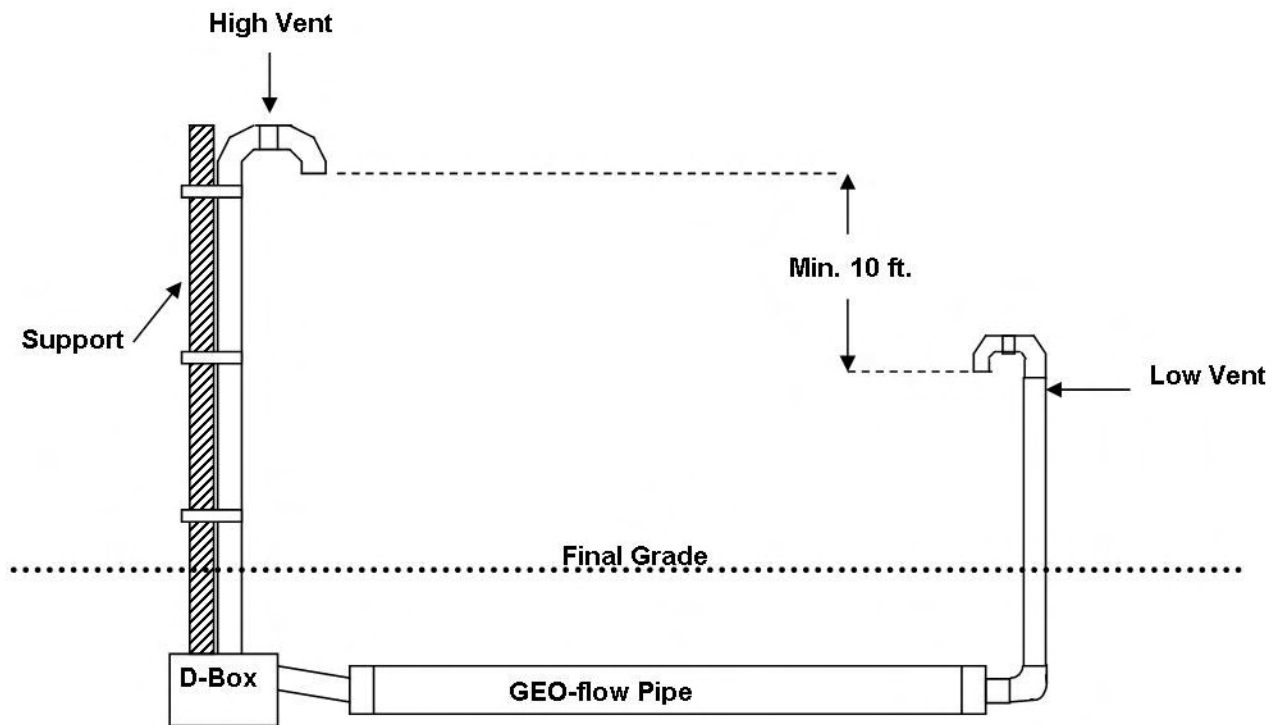
The GEO-flow Pipe system cannot directly accommodate pressure distribution. Effluent may be pumped from a septic tank or pump station to a GEO-flow Pipe disposal field, but the following conditions must be strictly met in order to assure proper function:

- A. Effluent cannot be pumped directly into the GEO-flow Pipe line(s). Effluent shall be pumped to a distribution box, and from that point gravity distributed into the GEO-flow Pipe system.
- B. Design dosing of pumped effluent into the distribution box prior to gravity distribution into the GEO-flow Pipe system shall occur at a rate of no greater than 20 gallons per minute (GPM).

XII. SYSTEM CONFIGURATIONS (continued)

6. Pressure Distribution, continued

- C. Differential venting is required on all GEO-flow Pipe systems which receive effluent from a pump. Differential venting is accomplished with the use of two vents – one extending from the distribution box and another at the other end of the line. The vent extending from the distribution box must extend a minimum of 10' higher than the elevation of the other.



Differential Venting (not to scale)

7. Venting Requirements

The following applications require the incorporation of venting in the GEO-flow Pipe system:

- any system to which effluent is pumped
- any system which is installed with more than 18" of cover material
- any system which is installed under surface materials (tarmac, crushed rock, etc.) that restrict air flow through the soil between the system and the grade.

One 4-inch vent is required for every 1000 feet of GEO-flow Pipe line.

Appendix I

SYSTEM INSTALLATION REPORT FORM

For each **GEO-Flow Pipe Leaching System** installed in Massachusetts, certified installers must complete the following form in its entirety. Copies of this completed form **must** be forwarded via fax or mail to (1) the local approving authority and (2) ADS/Hancor.

Property Owner:		
Site Address:		
City:		Zip Code:
Installer's Name:		
Installation Company's Name:		
Installation Company's Address:		
Installation Company's City:		State: Zip Code:
Installed System Type (Approval): General Use: Yes: _____ Remedial Use: Yes: _____		
Permit Number:		
System Type:		
Design Flow:		
Date of Installation Completion:		Date of System Start-up:
Comments:		

Mail or fax a copy of this completed form to (1) the local approving authority and (2) ADS/Hancor at:

ADS, Inc.
Stonybrook Industrial Park
58 Wyoming Street
Ludlow, MA 01056

Appendix II

GEO-Flow PIPE LEACHING SYSTEM

SYSTEM OPERATING MANUAL

The Massachusetts Department of Environmental Protection's approval for use of the **GEO-Flow Pipe Leaching System** requires that we provide a "**System Operating Manual**" to the system owner. This is that manual.

System Inspection:

Your **GEO-Flow Pipe Leaching System** will be inspected at least once annually by a manufacturer-certified operator/inspector. This is a requirement of the system approval.

Observation ports are required for each GEO-Flow Pipe Leaching System. These may be utilized for intermittent inspection as necessary.

System Maintenance:

Your **GEO-Flow Pipe Leaching System** is engineered to last a lifetime. The system itself requires very little maintenance. Consider the following information in order to promote your **GEO-Flow Pipe Leaching System's** longevity:

- Do not abuse the system (see section below).

- Have the septic tank pumped and inspected on a regular basis. "Regular" is a function of use.

- Consult with your system installer or inspector for guidance on proper pumping interval.

- Ensure that any venting, where applicable, remains functional.

Abuse:

Do not allow the system to be abused. "Abuse" is the primary cause of onsite wastewater treatment system malfunction. Avoid the following:

- Excessive volume. Your system has been designed and installed to operate under a specific design flow. Maintain use of the system within this design parameter.

- Solids. Keep solids out of the system. Paper products and feminine hygiene products should not be introduced into the system.

- Use of garbage disposals and water softeners. Garbage disposals and water softeners shall not be used with the GEO-Flow Pipe Leaching System.

- Cleaning supplies and medicines in high volume or concentration.

- Petroleum or fertilizers in any amounts.

Appendix III

GEO-Flow Pipe Leaching System TECHNOLOGY CHECKLIST FORM

Page 1 of 2

Every **GEO-Flow Pipe Leaching System** installed in Massachusetts **must** be inspected annually by an operator certified by ADS/Hancor to perform this inspection.

Operators inspecting a **GEO-Flow Pipe Leaching System** must complete the following form in its entirety. Operators must **also** complete a copy of the DEP Approved Inspection and O&M Form for Title 5 I/A Treatment and Disposal Systems. Copies of both of these completed forms **must** be mailed to MA DEP at the following address:

Department of Environmental Protection
Title 5 I/A Program
One Winter Street
Boston, MA 02108

17 1	General Description of Surface Conditions in Area of Soil Absorption System (describe):		
18	Is there "ponding" in the GEO-Flow System?	Yes:	No:
	If "Yes", estimate depth and describe effluent condition:		
19	Describe condition of D-box (if applicable):		
20	Are system vents in place and functional?	Yes:	No:
	If "No", explain:		
21	Describe any other relevant observations:		
22	Does the system include a Pump Chamber?	Yes:	No:
	If "Yes", continue with this section. If "No", move to bottom of form.		
23	Number of Pump(s):		
24	Condition of Pump(s) (describe):		
25	Does system have an alarm(s)?	Yes:	No:
	If "Yes", what condition are they in?		
	If "Yes", what was date of last alarm test?		

¹In describing condition of surface area around the soil absorption system, consider at a minimum the following:
 wetness/dryness of surface over system, or in area surrounding system;
 evidence of introduction of surface water/runoff or groundwater from other sources;
 evidence of breakout; and/or
 evidence of vehicular traffic loading.

Inspected by (print name):	
Telephone Number:	
Signature:	
I certify that I have inspected the GEO-Flow Pipe Leaching System at the address listed above and have completed this Technology Checklist Form. The information herein is accurate and complete as of the date of this inspection.	